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SHORT COMMUNICATION

Nesticus eremita (Araneae: Nesticidae): redescription of a potentially invasive European spider found in New Zealand

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Abstract. *Nesticus eremita* Simon 1879 is naturally found in caves in southern Europe. It has also invaded and established itself in Germany and has now been found in an abandoned air-raid tunnel in Auckland, New Zealand. A diagnosis, redescription, full synonymy and illustrations are presented to aid in the identification of this potentially invasive spider.

Keywords: Cave spider, invasive species, taxonomy, troglophile

A number of species in the family Nesticidae have invaded areas outside their natural range. *Nesticus cellulanus* (Clerck 1757) is originally from Europe, but is now found in the northeastern USA and Québec (Gertsch 1984; Paquin & Dupérré 2003; Paquin & Hedin 2005). *Eidmanella pallida* (Emerton 1875) was originally from North and Central America (Gertsch 1984), but is now found throughout the world (Platnick 2011). *Nesticella mogera* (Yaginuma 1972), is native to Asia but introduced to Fiji, Germany and Hawaii (Lehtinen & Saaristo 1980; Gertsch 1984; Kielhorn 2009).

Here we document another nesticid that has spread outside its natural range. *Nesticus eremita* Simon 1879 occurs naturally in caves throughout Italy, southeast France, Corsica, Switzerland, Slovenia, Croatia, Montenegro, Bosnia-Herzegovina and Greece (Lessert 1906, 1910; Kratochvíl 1933; Dresco 1966; Dresco & Hubert 1967; Brignoli 1971, 1977; Deeleman-Reinhold 1974; Maurer & Hänggi 1990). It is also found in cave-like synanthropic habitats (e.g., tunnels, cellars, catacombs, railroad track ballast, wells) in its natural range (Brignoli 1971; Maurer & Hänggi 1990) and where it is adventive in Austria (Knoflach & Thaler 1998) and Germany (Jäger 1995, 1998; Staudt 2010). *Nesticus eremita* has established populations in sewer tunnels in the German cities of Cologne, Mainz and Mannheim (Jäger 1995, 1998). These cites are all on the Rhine River, and *N. eremita* may have spread downstream from its endemic range in the Alps either naturally or via human transport (Jäger 1998). Given that the sewer tunnels in which *N. eremita* was found were not much more than 100 years old (Jäger 1995, 1998) and that the spider fauna of Central Europe is well known (e.g., Heimer & Nentwig 1991), it appears that *N. eremita* has become established in Germany comparatively recently.

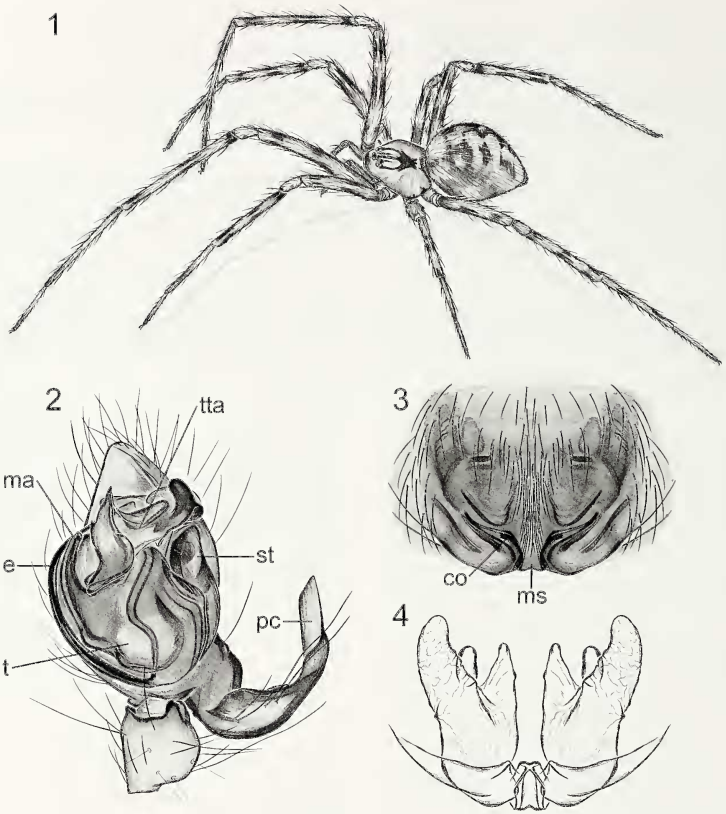
On 21 June 2000, CJV and Grace Hall went to an abandoned air-raid tunnel in Alten Reserve (36°51.04′S, 174°46.42′E) in central Auckland in search of the Australian stiphidiid *Procambridgea grayi* Davies 2001, which had been collected from there in 1999 (Davies & Lambkin 2001). No specimens of *P. grayi* were found, but a single male *N. eremita* was collected from a web near the entrance of the tunnel. Neither collector recognized the specimen as belonging to Nesticidae, as that family had not been recorded from New Zealand (Paquin et al. 2010; Sirvid, et al. 2011). The specimen was preserved in 70% EtOH, labeled and put amongst the unsorted material at the New Zealand Arthropod Collection (NZAC); it remained there until November 2010 when CJV noticed it while searching for specimens of Mimetidae.

It seems almost certain that *N. eremita* arrived in Auckland via a shipping container, as the tunnel entrance in Alten Reserve is only 600 meters from the Port of Auckland, which is one of New Zealand's busiest seaports. The air-raid tunnels beneath Albert Park in Auckland city are extensive and were partially filled with unfired bricks at the end of the Second World War, when most of the entrances were blocked off (Pilkington 2008).

The male specimen collected had built a web and was in good condition. It would be extremely unlikely that the single male collected had lived long enough to stow away with cargo, made the journey from Europe to New Zealand (it takes about 40 days for a cargo ship to sail from Italy to Auckland (M.R. McNeill pers. comm.)), walked the 600 m from the port to the tunnel and then made a web. It is more likely that the male was part of an established population or, at the very least, the offspring of a gravid female that did live long enough to make the journey from Europe. The establishment of *N. eremita* in Auckland needs further confirmation. Unfortunately, the entrance to the tunnel where the single male specimen of *N. eremita* was collected in 2000 has since been blocked off, so it was not possible to search for further specimens and confirm whether there is still a population there.

Given that people generally do not spend a great deal of time looking for small spiders in sewers and abandoned tunnels, it is quite possible that *N. eremita* has spread to other parts of the world and established undetected populations. The presence of *N. eremita* in human-made tunnels in Auckland, Cologne, Mainz and Mannheim does not present an immediate threat to natural ecosystems. However, if this species were to spread to natural cave systems outside its native range, it has the potential for making ecological impacts. Invasive spider species can harm endemic spiders through competitive displacement (Nyffeler et al. 1986; Hann 1990; Bednarski et al. 2010), and invasive arthropod predators can impact native communities (Snyder & Evans 2006). This may be even more of a concern in cave ecosystems, which may be more at risk from ecological disturbance (Reeves 2001).

The species descriptions of *N. eremita* are all in relatively inaccessible publications, not in English or do not feature diagnostic illustrations of male and female genitalia together. To facilitate the identification of this potentially invasive species we present a full synonymy, diagnosis, brief redescription and illustrations of the habitus, male pedipalp and female epigynum. Terminology of the male pedipalpal structures follows Agnarsson et al. (2007).



Figures 1–4.—*Nesticus eremita*, female from Mannheim, male from Mainz, Germany. 1. Habitus, female; 2. Male left pedipalp, ventral view, tta = theridioid tegular apophysis, e = embolus, ma = median apophysis, t = tegulum, st = subtegulum, pc = paracymbium; 3. External genitalia, ventral view, co = copulatory opening, ms = medium septum; 4. Internal genitalia, dorsal view.

TAXONOMY

Nesticidae Simon 1894
Nesticinae Simon 1894
Nesticus Thorell 1869
Nesticus eremita Simon 1879
(Figs. 1–4)

Nesticus eremita Simon 1879:258; Simon 188:48, pl. 26, fig. 8; Lessert 1906:610, pl. 20, figs. 3–5; Lessert 1910:300, figs. 164–166; Simon 1929:658, 753, figs. 1015, 1016; Dresco 1966:805; Dresco & Hubert 1967:3; Brignoli 1971:206, figs. 118–122; Deeleman-Reinhold 1974:12, fig. 9; Brignoli 1975:28; Kratochvíl 1978:39, figs. 3, 4; Thaler 1981:274, figs. 6, 8; Heimer & Nentwig 1991:276, fig. 732; Jäger 1998:13, fig. 1A.

Theridion parenzani Trossarelli 1931:13, fig. 1 (Synonymized by Brignoli 1975);

Nesticus strasseri Roewer 1931:14, fig. 11, 13c, d (Synonymized by Kratochvíl 1933).

Nesticus eremita italica Caporiacco 1934:401, figs. 2, 3 (Synonymized by Dresco & Hubert 1967).

Nesticus speluncarum eremita Kratochvíl 1933:40, 63, figs. 3, 13, 14, 27–30; Wiehle 1963:435, figs. 8–10; Wiehle 1967:193, figs. 45, 46 (Synonymized by Dresco & Hubert 1967).

Ivesia eremita Lehtinen & Saaristo 1980:51 (Transferred from *Nesticus*).

Material examined.—NEW ZEALAND: Auckland, Alten Reserve, 21 June 2000, C.J. Vink & G. Hall leg, 1♂ (NZAC). GERMANY: Mannheim, 24 November 1997, P. Jäger leg. 1♂ 1♀ (AMNH); Mainz, 21 May 1996, P. Jäger leg. 1♂ 1♀ (AMNH).

Diagnosis.—*Nesticus eremita* can be distinguished from other Nesticidae by features of the male pedipalp (Fig. 2), particularly the structure of the theridioid tegular apophysis, the shape of the large, unbranched paracymbium and the structure of the external genitalia of the female (Fig. 3). The theridioid tegular apophysis is more compact than that of *N. cellulanus*, and the distal end of the paracymbium is rounded. The slit-like copulatory openings of the

external genitalia diverge anteriorly and the medium septum narrows posteriorly, whereas in *N. cellulanus*, the copulatory openings converge anteriorly, and the medium septum is wide posteriorly.

Redescription.—Color in alcohol: Male carapace light yellow; abdomen off-white; legs yellow, metatarsi, tarsi of legs I, II light orange. Female carapace light yellow with black trident-shaped mark extending from fovea to lateral eyes (Fig. 1); abdomen off-white with dark pattern (Fig. 1); legs yellow-orange with dark bands (Fig. 1).

Male pedipalp (Fig. 2): theridioid tegular apophysis compact, with several pointed projections; paracymbium long, unbranched with rounded end. Male chelicerae with 3 promarginal teeth, 5 retromarginal denticles.

Epigynum (Fig. 3) with slit-like copulatory openings that diverge anteriorly, medium septum narrow posteriorly; internal genitalia (Fig. 4) with branched spermathecae. Female chelicerae with 3 promarginal teeth, 10 retromarginal denticles.

Dimensions (mm). Male (Auckland): total length 3.5; carapace length 1.9, width 1.8, height 0.8; abdomen length 2.6, width 1.4; sternum length 1.1, width 1.1; total length of leg I 16.7, leg II 11.7, leg III 8.7, leg IV 11.9. Female (Mainz): total length 5.2; carapace length 2.1, width 1.7, height 0.9; abdomen length 3.3, width 2.3; sternum length, 1.1, width 1.1; total length of leg I 15.8, leg II 10.9, leg III 7.7, leg IV 11.2.

Variation.—Female: Carapace length 1.7–2.6; total length 3.8–5.4. Male: Carapace length 1.7–2.3; total length 3.5–4.7. Based on material examined and Jäger (1998). The degree of pigmentation in *N. eremita* can vary (Jäger 1998); we observed uniformly light colored specimens and specimens with a contrasting color pattern on the abdomen and legs (Fig. 1).

Distribution.—*Nesticus eremita* is found in caves in its natural range throughout Italy, southeast France, Corsica, Switzerland, Slovenia, Croatia, Montenegro, Bosnia-Herzegovina and Greece. It has also been found in synanthropic habitats (e.g., tunnels, cellars, catacombs, railroad track ballast, wells) in Italy, Switzerland, Austria, Germany and New Zealand (Auckland).

Biology.—Like most nesticids, *Nesticus eremita* is a troglophile. Specimens of *N. eremita* that live well away from sunlight have less somatic pigmentation and reduced tapeta (Jäger 1998).

DNA sequences.—DNA sequences from the mitochondrial genes cytochrome *c* oxidase subunit 1 (COI) (GenBank accession number EU746436) and 16S ribosomal RNA (EU746445) were reported in López-Pancorbo & Ribera (2011).

Remarks.—The position of the trichobothrium on metatarsus 1 has been promoted as an important character for distinguishing between *N. eremita* and *N. cellulanus* (Wiehle 1963; Thaler 1981; Heimer & Nentwig 1991) and for higher nesticid taxonomy (Lehtinen & Saaristo 1980); however, Jäger (1998) found that this character was not diagnostic between *N. eremita* and *N. cellulanus*. Lehtinen & Saaristo (1980) transferred *Nesticus eremita* to the genus *Ivesia* Petrunkevitch 1925, but Kaston (1945) and Gertsch (1984) considered *Nesticus* a senior synonym of *Ivesia*. The pedipalpal sclerites of *N. eremita* are similar to those of *N. cellulanus*, the type species of *Nesticus*, and appear to be homologus. These two species also appear to be closely related based on a phylogenetic analysis of mitochondrial DNA (López-Pancorbo & Ribera 2011). There are European *Nesticus* species with greater morphological similarities to *N. eremita* (e.g., *N. speluncarum* Pavesi 1873, *N. henderickxi* Bosselaers 1998), but unlike *N. cellulanus*, these species are only known from their natural cave habitats and have limited distributions (Dresco 1966; Brignoli 1971; Bosselaers 1998).

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